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Department: MBBS

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Course: General Embryology

Assignment (Answers)

1. Ovulation is the process by which matured secondary oocyte is released from the ovarian follicle. Ovulation normally occurs midway through the menstrual cycle. Ovulation is a process facilitated by hormones. Just before ovulation an abrupt increase in Luteinizing Hormone (LH) during the final development of vesicular follicle causes the primary oocyte to complete meiosis 1 and causes the follicle to enter pre-ovulatory mature vesicular stage.

For the oocyte to be released, two events caused by LH surge occur;

1. It increases collagenase activity, resulting in digestion of collagen fibres surrounding the follicle
2. Prostaglandin levels also increase and cause local muscular contractions in the ovarian wall.

These contractions cause ovulation in which the oocyte floats out of the ovary. When the oocyte floats out, some of the cumulus oophorus cells rearrange themselves around the zona pellucida to form the corona radiata. Ovulation usually follows the LH peak by 12-24 hours. Signs of ovulation include abdominal pains (mittelschmerz - middle pain), swollen vagina, increase libido, changes in cervical mucus etc.

Failure to ovulate, known as anovulation, is caused by low gonadotropins and in such case; drugs can be administered although the drugs often cause multiple ovulations.

1. Differences between meiosis 1 and meiosis 2

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| Meiosis 1 | Meiosis 2 |
| 1. In prophase 1, synapsis, crossing over and chiasma formation occur
 | In prophase 2, synapsis, crossing cover and chiasma formation do not occur  |
| 1. In metaphase 1, 46 homologous duplicated chromosomes align at the metaphase plate
 | In metaphase 2, 23 homologus duplicated chromosomes align at the metaphase plate |
| 1. In anaphase 1, 46 duplicated chromosomes separate from each other and move towards the different poles
 | In anaphase 2, 23 duplicated chromosomes separate from each other and move towards different poles  |
| 1. In anaphase 1, the centromere does not split
 | In anaphase 2. The centromere splits |
| 1. At the end of meiosis 1, 2 daughter cells are produced
 | At the end of meiosis 2, 4 daughter cells are produced |
| 1. It is preceded by interphase
 | Interphase does not Loccur |
| 1. Reduces the chromosome number in the daughter cells
 | An equal number of chromosomes in both parent and daughter cells |

1. Stages involved in fertilization
2. Passage of sperm through corona radiate: sperm cells have to be capacitated (i.e the removal of glycoprotein coat and seminal plasma proteins from the plasma membrane that overlies the acrosomal region of spermatozoa) before they can pass the corona radiate freely
3. Penetration of zona pelluicda: zona pellucida maintains sperm binding and induces acrosome reaction. Specific proteins on the sperm bind to the ZP3, a zona glycoprotein on the zona pellucida. This releases acrosin, an acrosomal enzyme which facilitates the penetration of the zona pellucida and thereby gives way to the plasma membrane of the oocyte. Lysosomal enzymes are released once the head of the sperm touches the oocyte surface. These enzymes alter the properties of the zona pellucida to prevent sperm penetration and to inactivate binding sites for spermatozoa on the zona pellucida surface.
4. Fusion of plasma membrane of the sperm and oocyte: the membranes fuse and break down at the point of fusion and only the head and tail of the sperm enter the cytoplasm of the oocyte while the plasma membrane remains behind.
5. Completion of meiosis 2 and formation of pro-nucleus: penetration of oocyte activates the completion of meiosis 2, hence forming a mature oocyte and polar body. The nucleus of the matured oocyte is called the female pro-nucleus.
6. Formation of male pronucleus: the nucleus of the sperm enlarges to form the male pro-nucleus and the tail of the sperm degenerates. Since all the mitochondria of the sperm are in its tail and the tail degenerates, all the sperm mitochondria also degenerate and hence all mitochondria in the zygote are maternal. The oocyte which now contains 2 pro-nuclei is called an ootid.
7. Fusion of pro nuclei to give zygote: the two pro-nuclei fuse to give a diploid cell, the zygote
8. Differences between monozygotic and dizygotic twins

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| Monozygotic twins | Dizygotic twins |
| 1. Monozygotic twins are developed by the splitting of a fertilized embryo into two.
 | Dizygotic twins are developed by two separate fertilization events occurring at the same time.  |
| 1. The cause for monozygotic twins is not known.
 | Dizygotic twins are caused either by IVF, certain fertility drugs or hereditary predisposition due to the hyperovulation. |
| 1. The genetic codes of the monozygotic twins are nearly identical.
 | The genetic codes of the dizygotic twins are same as any other sibling. |
| 1. The genders of monozygotic twins are same.
 | The genders of dizygotic twins are different. |
| 1. The blood types of monozygotic twins are the same.
 | Dizygotic twins may have different blood types. |
| 1. Mainly diamniotic, monochorionic with single placenta
 | Mailnly have two amnions with two chorions and two placentas |
| 1. Monozygotic twins are extremely similar. But, they may vary depending on the environmental factors.
 | The appearance of dizygotic twins is similar as any other sibling. |